



# **DUCT SEALANT LONGEVITY R&D**

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# **OBJECTIVES**

- **Develop Test Methods for Duct Sealant Longevity**
- **Evaluate Sealant Types**
- **Facilitate Development of Consensus Standards (ASTM)**
- **Technology Transfer**

# PROJECT HISTORY

- **1995: CIEE/PG&E Funding**
- **1997: First Cycling Data**
- **1998: First Published Articles**
- **1999: Mark II Device (DOE)**
- **2000: CIEE/PG&E Phase II**
- **2001: PIER Funding**

# **JOINT TYPES**

- **Core-To-Collar**
  - **Industry focus**
- **Collar-To-Plenum**
  - **Used in CIEE/PG&E work**
- **Jacket-To-Collar/Jacket**
  - **Moisture/Lifetime issues**

# **Why Collar-to-Plenum?**

- **Observed Field Failures**
- **Toughest Leak to Seal**
- **Easiest to Quantify**
  - **Mechanical vs. air seal**
  - **Fixed worst case**
- **Test to Failure**

# Duct Tape Failure



# Original Longevity Testing

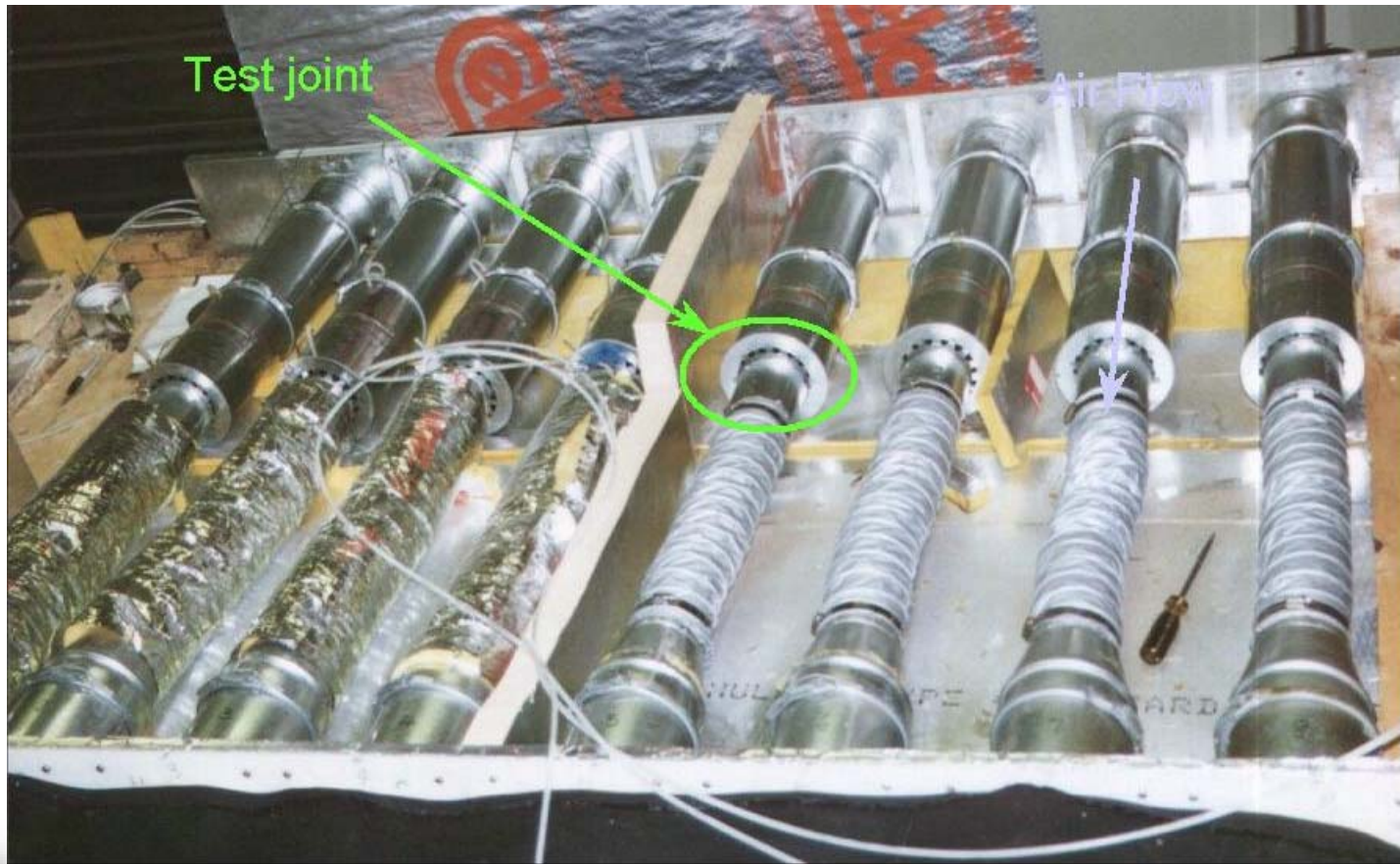
- **Baking: Samples were placed in an oven heated to 60°C -80°C (140°F to 176 °F).**
- **Aging: Samples had alternating hot and cold air blown through them and pressure cycling**
  - **Heating**
    - duct surface about 60°C (140°F)
    - pressure difference about 100 Pa
  - **Cooling**
    - duct surface about 0°C (32°F)
    - -pressure difference about 200 Pa

# Duct Sealants

- **(Cloth) Duct Tape** has a vinyl or polyethylene backing with fiber reinforcement and has a natural (non-butyl) rubber adhesive.
- **OPP Tape** has a thin typically clear polypropylene backing and an acrylic adhesive.
- **Foil Tape** has metal foil backing and like OPP tape has an acrylic adhesive.
- **Butyl Tape** typically has foil backing as well, but uses a thick (0.38 to 1.3 mm) butyl adhesive to allow it to conform to more irregular shapes.
- **Mastic** is wet application, gooey adhesive that fills gaps and dries to a semi-rigid solid.
- **Aerosol Sealant** is a sticky vinyl polymer that is applied to the leaks internally, by blowing aerosolized sealant through the duct system.



# Original Longevity Apparatus



# Low-flow duct leakage measurement apparatus



# RESULTS

- **(Cloth) Duct Tapes Failed**
  - **UL 181B-FX**
  - **Others**
- **Nothing Else Failed**
  - **Tapes: Foil, Butyl, OPP**
  - **Mastic**
  - **Aerosol**

# Observed Failures

- **Drying/hardening of adhesive**
- **Shrinking of tape backing**
- **Delamination of backing/fiber/adhesive**
- **Tapes pull away or fall off**
- **Tapes stay in place, but shrink to uncover leaks**
  - **Some tapes reset in shrunk position**

# TAPE SUMMARY

BACKING	ADHESIVE	STATUS
Cloth	Natural Rubber	Fail
OPP	Acrylic	Pass
Foil	Acrylic	Pass
Foil	Butyl Rubber	Pass
?	?	New Products



# Mark II Apparatus

- **More cycling samples**
- **More UL 181B-FX Samples**
- **Heat only samples**
- **Cool only samples**
- **SAME RESULT**



# Industry Issues

- **Test Core-to-Collar**
  - **Industry recommendations are for core-to-collar joint**
- **Recommended Configuration**
- **Want to get to “Pass”**

# CURRENT TESTING

- **Core-to-Collar Joint**
  - 18 Configurations
- **Heating Only**
  - 200F (Max. Op. Temp)
- **Acceptance Testing**
  - 2 yr Test=30 yr equivalent
  - 6 mo. w/Visual Criteria





# **18 CONFIGURATIONS**

- **Industry Recommendation**
  - **2 Continuous Wraps; Strapping**
- **Field Variations**
  - **Discontinuous, 1 Wrap, No Strap**
- **Multiple Tapes**
  - **2 Duct Tapes, Foil, OPP**
  - **Clean surfaces**

# **1-Month RESULTS**

- **Little Leakage**
- **Minor Visible Changes**
  - **Wrinkling, oozing**
- **1 Significant Change**
  - **Shrinking, delaminating**
  - **Probably will worsen**

# One Wrap; No Strap



# CONCLUSIONS

- **Do Not Use Duct Tape**
  - **On Collar-to-Plenum Joint**
- **Do Not Use Duct Tape**
  - **If Industry Recommendations Are Not Followed**
- **Testing is Incomplete**

# OPEN QUESTIONS

- **Which configurations, if any, of “Duct Tape” work?**
  - **Lab, Field**
- **Is it the natural rubber adhesive or cloth backing?**
- **How to qualify products?**
  - **Improved Test Method**

# CONTINUED TESTING

## Core-to-Collar

- **At least 6 months more**
- **Many Configurations**
- **Other Products?**

## New Products

- **Use Collar-to-Plenum**
- **At least 60 days each**
- **Develop Criteria**

# RECOMMENDATION 1

- **Delete “unless” clause**
  - **No justification that it works**
  - **Could make it worse**
- **Edits (e.g. add “adhesive”)**

D. Joints and Seams of duct systems shall not be sealed with cloth-back rubber adhesive duct tapes ~~unless such tape is used in combination with mastic and drawbands.~~

# RECOMMENDATION 2

***Include Exception Only if:***

- **Sufficient inspection**
  - **Other configurations failing**
- **Beaded collar is required**
  - **Core could pull off collar**



# RECOMMENDATION 3

- **Broader Restriction**
- **Expedited Process for New Products**

D. Joints and Seams of duct systems shall not be sealed with either cloth-back or natural rubber-adhesive ~~duct~~ tapes unless the Commission finds that the tape meets appropriate longevity requirements.

# JACKET-TO-? JOINT

- **Not covered in standards**
- **Can allow condensation**
- **Impacts duct serviceability**

